General information for organic Chem

IB Chemistry

Topic 10 – Organic

Modified From:

Larry Scheffler, LHS, OR

Types of Reactant

Saturated	Unsaturated
•Compounds which contain only single bonds •For example: alkanes	•Compounds which contain double or triple bonds •For example: alkenes, arenes
Aliphatics	**Arenes**
•Compounds which do not contain a benzene ring; may be saturated or unsaturated •For example: alkanes, alkenes	•Compounds which contain a benzene ring; they are all unsaturated compounds •For example: benzene, phenol
Electrophile (electron-seeking)	**Nucleophile (nucleus-seeking)**
•An electron-deficient species which is therefor attracted to parts of the molecules which are electron rich •Electrophiles are positive ions or have a partial positive charge •For example: NO_2^+ , H^+ , $Br^{\delta+}$	•An electron-rich species which is therefore attracted to parts of molecules which are electron deficient •Nucleophiles have a lone pair of electrons and may also have a negative charge •For example: Cl^- , OH^- , NH_3

Types of Reaction

Addition	•Occurs when two reactants combine to form a single product •Characteristic of unsaturated compounds •For example: $CH_4 + Br_2 \rightarrow C_2H_4Br_2$
Substitution	•Occurs when one atom or group of atoms in a compound is replaced by a different atom or group •Characteristic of saturated compounds and aromatic compounds •For example: $CH_4 + Cl_2 \rightarrow CH_3Cl + HCl$
Elimination	•Occurs when a small molecule is lost form a larger compound •Usually results in the formation of a double or triple bond •When the molecule eliminated is H_2O, the reaction is dehydration •For example: $C_2H_5OH \rightarrow C_2H_4 + H_2O$
Addition-Elimination	•Occurs when two reactants join together (addition) and in the process a small molecule such as H_2O, HCl or NH_3 is lost (elimination) •Reaction occurs between a functional group in each reactant •Also called **condensation** reaction •For example: $RNH_2 + R`COOH \rightarrow R`CONHR + H_2O$

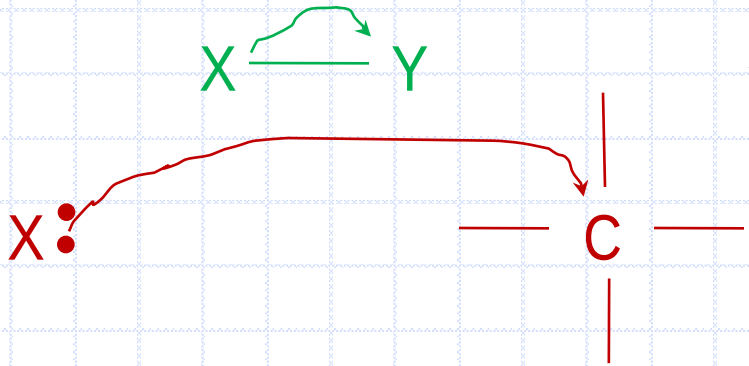
Types of Bond Breaking (bond fission)

Homolytic fission	Heterolytic fission
•When a covalent bond breaks by splitting the shared pair of electrons between the two products •Produces two free radicals each with an unpaired electron	•When a covalent bond breaks which both the shared electrons going to one of the products •Produces two oppositely charged ions

Convention for depicting organic reaction mechanisms

- Showing movement of electrons
  - Within bonds and between reactants
- The curly arrow is used
  - Drawn from the site electron availability to the site of electron deficiency.

Represents e- pair being pulled towards Y so Y becomes δ- and X becomes δ+



Nucleophile X attracted to e-deficient C

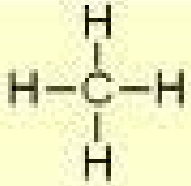
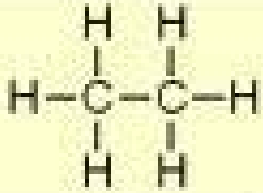
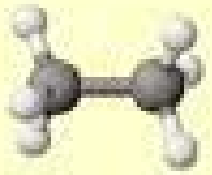
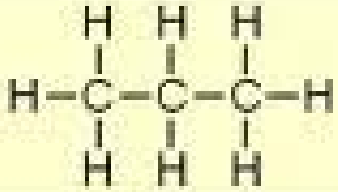
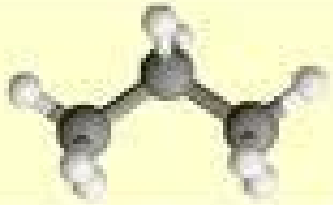
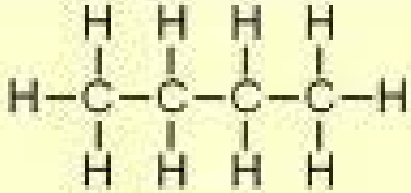
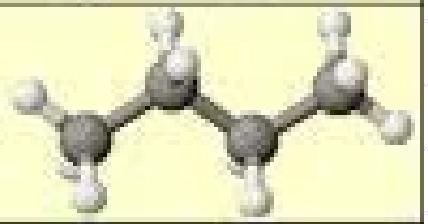
The double-headed arrow represents the motion of an electron pair. When electrons are fully transferred through several steps they are known as the “leaving group.”

Members of Homologous Series

- Differ by a CH_2
- Can be represented by the same general formula
- Show gradation in physical properties
- Have similar chemical properties

Members of Homologous Series…

… differ by a $-CH_2$ group

methane CH_4		
ethane C_2H_6		
propane C_3H_8		
butane C_4H_{10}		

Members of Homologous Series…

… can be represented by the same general formula

Formula	Name
CH_4OH	Methan-1-ol
C_2H_5OH	Ethan-1-ol
C_3H_7OH	Propan-1-ol
C_4H_9OH	Butan-1-ol
$C_5H_{11}OH$	Pentan-1-ol
$C_6H_{13}OH$	Hexan-1-ol
$C_7H_{15}OH$	Heptan-1-ol
$C_8H_{17}OH$	Octan-1-ol

Members of Homologous Series…

… show gradation in physical properties

Alkane	Boiling Point
Methane, CH_4	-164
Ethane, C_2H_6	-89
Propane, C_3H_8	-42
Butane, C_4H_{10}	-0.5
Pentane, C_5H_{12}	36
Hexane, C_6H_{14}	69
Heptane, C_7H_{16}	98
Octane, C_8H_{18}	125

- Since the series differ by one $–CH_2$ they have successively longer carbon chains
  - Results in gradual trend of phy. Props
  - Not always a linear growth
  - Density and viscosity are other examples

Members of Homologous Series…

… show similar chemical properties

- As the have the same functional group
  - Ex.1 – the alcohols have a functional –OH group, which can be oxidized to form organic acids
  - Ex. 2 – the –COOH functional group, present in the homologous series of the **carboxylic acids**, is responsible for the acidic properties of these compounds

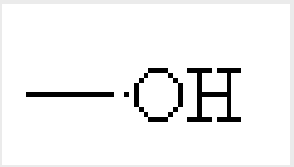
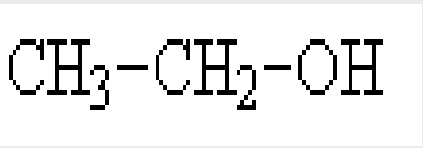
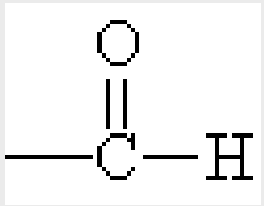
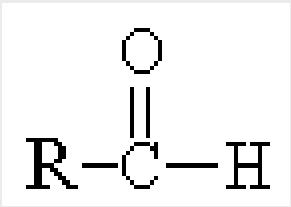
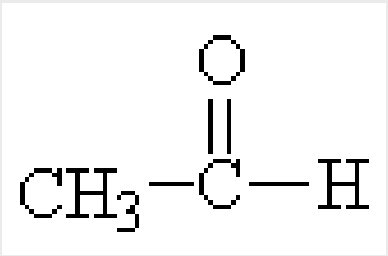
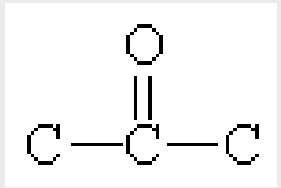
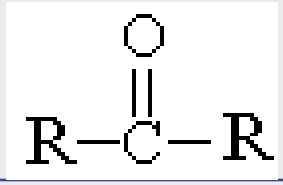
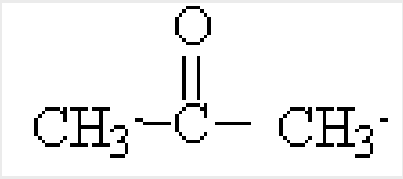
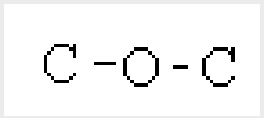
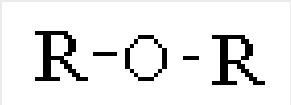
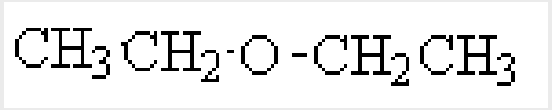
Hydrocarbons

- Hydrocarbons are organic compounds that are made up of only carbon and hydrogen.
- There are several different categories of hydrocarbons including:
  - Alkanes
  - Alkenes
  - Alkynes
  - Cyclic Hydrocarbons
  - Aromatic hydrocarbons

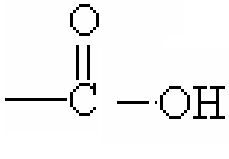
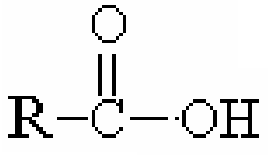
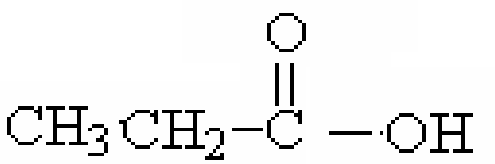
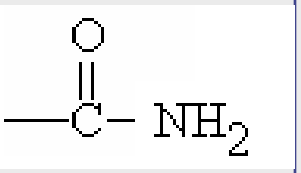
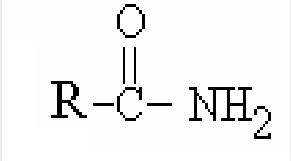
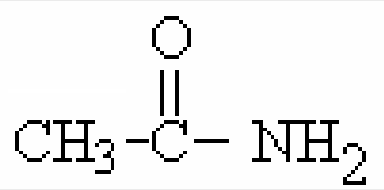
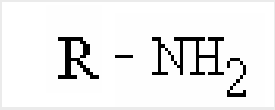
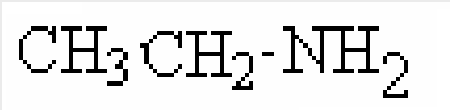
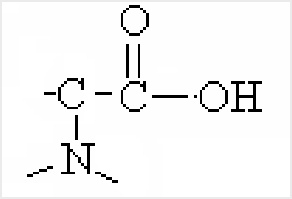
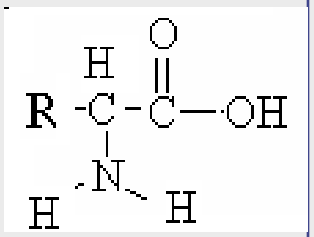
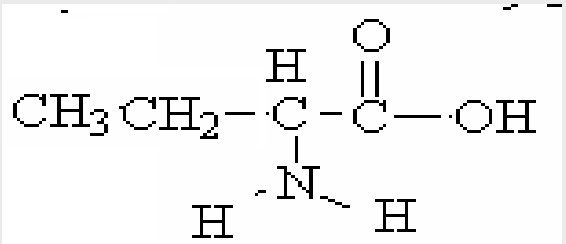
Functional Group Nomenclature

alcohols	“ol”	**Amides**	“amide”
Aldehydes	“al”	**Amines**	“amine” or amino as a prefix
Ketones	“one”	**Ethers**	Ethoxy as prefix
Acids	“oic”	**halohydrocarbons**	Fluoro, bromo, chloro or iodo
Esters	“oate”		

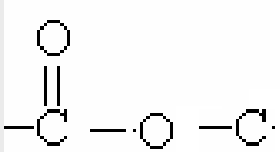
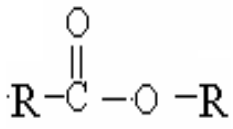
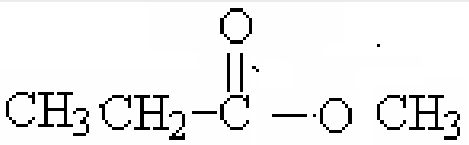
Functional Groups

Alcohol		**R- OH**	
Aldehyde			
Ketone			
Ether			

Functional Groups

Carboxylic Acid			
Amide			
Amine			
Amino acid			

Functional Groups

Ester			
Thiol	-S-H	R- SH	CH_3CH_2-SH